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VIDEO PROBE INSPECTION OF ROOFBOLT HOLES AT STOBIE MINE

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ABSTRACT

Sixty roofbolt holes at the Stobie Mine of INCO Ltd., Sudbury, have been inspected with a colour videoprobe and recorded on videotape. The records are needed as a background document for site description for an in situ trial in the Swellex roof support system. The test site is located on 2200 level at the 2240 footwall drift. The rock mass at the site can be classifed as poor to good. Sub-horizontal fractures occur in nearly all roofbolt holes with no distinct concentration at a particular portion of the holes. Borehole breakouts are common features.

The field trial of the video probe unit showed that the performance of instruments can be affected by the underground environment. Adequate protection is necessary for more effective use of equipment.

Key words: Video probe unit; Video borehole survey; Swellex roofbolts.

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INSPECTION A LA SONDE VIDEO DE TROUS DE BOULON DE TOIT A LA MINE STOBITE

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RESUME

Soixante trous de boulon de toit à la mine Stobie d'INCO, à Sudbury, ont été inspectés au moyen d'une sonde vidéo couleur, et les images, enregistrées sur bande vidéo. Les enregistrements sont nécessaires comme information de fond pour la description des lieux dans les essais in situ du système de soutènement du toit Swellex. Le lieu d'essai se trouve au niveau 2200 dans la galerie de l'éponte inférieure 2240. La masse rocheuse peut être classée de médiocre à saine. Il ya a des fissures sub-horizontales dans presque tous les trous de boulon de toit sans que leur concentration soit particulière dans une certaine proportion des trous. Les effondrements dans le trous de sonde sont fréquents.

L'essai sur le terrain de la sonde vidéo a révélé que le rendement de l'instrument peut varier selon la nature du sous-sol. L'utilisation efficace du matériel nécessite une protection adéquate.

Mots clés: sonde vidéo; diagraphie vidéo; boulons de toit Swellex.

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INTRODUCTION

Three prototypes of stainless steel Swellex bolts developed by Atlas Copco have been produced with the support of Atlas Stainless, Associated Tube Industries and the Nickel Development Institute (1). The Nickel Development Institute has the leadership of the project in field testing the recently produced bolts.

On request by the Nickel Development Institute, in cooperation with INCO Ltd. and Falconbridge Ltd. a video survey of a set of boreholes was conducted prior to installation of the bolts. The first phase of the project carried out at Kidd Creek Mine, Timmins, has been completed (2). At the Stobie Mine, drilling of boreholes was completed on February 3, 1989, and the video inspection of holes was carried out on February 7 and 8, 1989. Figure 1 shows the location of the mine in the Sudbury mining district.

The video inspection will provide a permanent photographic record of structural features of the boreholes. After installation of Swellex bolts, one of each of the three types of bolts will be overcored using 152 mm (6") diameter coring bits. The overcoring sessions are planned in periods of 12 months, with the first phase of overcoring at about 6 months after installation of the bolts.

An evaluation of structural data recorded by the video survey and observed in the rocks surrounding the overcored bolts may provide information on corrosion mechanisms and rockbolt behaviour.

VIDEO EQUIPMENT

The video probe 2000 equipment consists of a video probe, a video processor, a colour monitor, a character generator keyboard, and a standard video cassette recorder (VCR), as illustrated in Figure 2 (3). The video

probe 2000 system is manufactured by Welch Allyn Inc., video division. The equipment was obtained on loan from INCO Ltd., Copper Cliff, Ontario.

The operation of the system requires an AC power supply of 110 volts, 15A/60Hz. The video probe has a length of 15.2 m and the camera head and cable are 10.2 mm O.D. The probe provides an axial view, but can be equipped with a side viewing attachment (a reflection mirror). On viewing the video display the observer needs to consider that the linear magnification is about 5 times and the areal magnification is 28 times.

The image on the monitor can be complemented by written comments through keyboard entries or by spoken comments with the aid of a microphone. The illlumination on the video processor is controlled by an automatic level controller which makes the operation effective. Manual control of illumination is also provided.

For the inspection of boreholes the video probe cable and camera head were fed through aluminum rods (O.D. = 21 mm, I.D. = 15 mm) and tied to the top of the rods. This positioned the camera head nealy in the hole centre, allowed rotation of the probe in the hole, and protected the cable. The first section of the rods (1.8 m) was marked at 5 and 10 cm intervals to record the position (distance) of fractures from the borehole collar during the survey.

VIDEO BOREHOLE INSPECTION

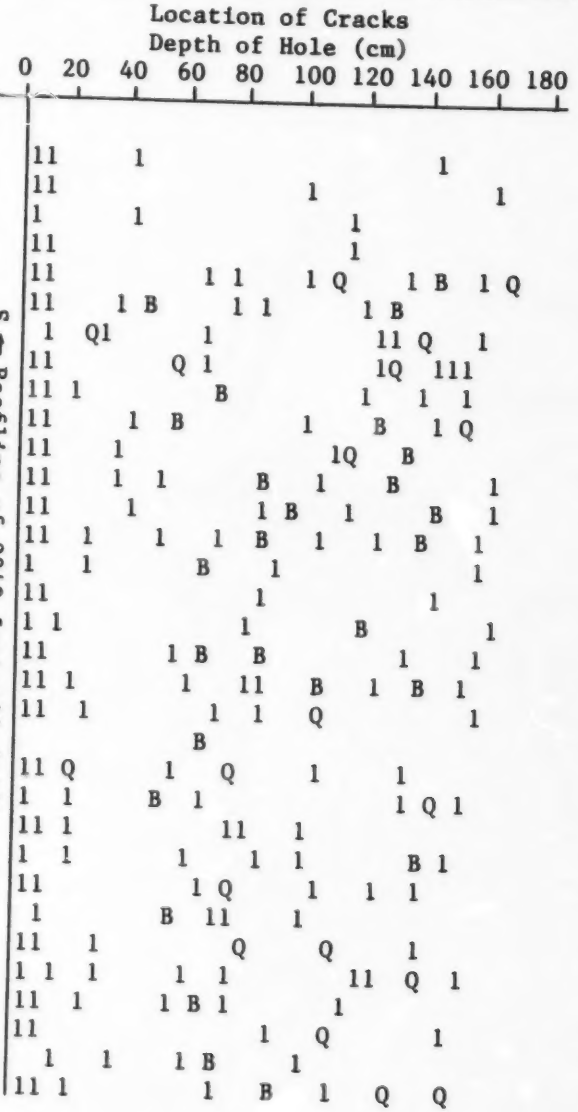
The selected Swellex bolts test site was located on 2200 level at the 2240 footwall drift as shown in the mine plan in Figure 3. The drift roof at the test site is supported with bolts and screened with wire mesh because of poor ground conditions (broken and lose rocks). The rock mass can be classified as poor to good. The rock type is locally defined as greenstone. The roof in the test area is wet with local water flows. Water from the working level above the drift infiltrates through open fractures.

Twenty sets of three boreholes (holes and sections approximately 1.22 m apart) had been drilled 1.8 m deep into the roof. EX-size non-coring bits (O.D. = 38 mm) were used to drill the holes. Locations of surveyed boreholes and details of layout are shown in Figure 4. The boreholes started with section (row) number 1 at the South and progressed towards North until section number 20. The video recordings of the holes followed the same sequence, i.e., beginning at the South and progressing North until section number 20 was recorded. At the individual sections the recording started at the East hole followed by vertical and West hole. The hole identification numbers consist of a seven position alpha-numeric code with the first two identifying the mine (ST = Stobie), the next two the level (22 = 2200 level), the next letter the location (E = East, V = vertical, W = West), and the last two digits, the section number (02 = section number 2). Fifty-nine of the 60 boreholes were inspected and recorded on colour video tape. The video recording starts at the collar and after reaching the bottom of the hole the video probe is lowered slowly to display the axial view of the hole wall. The video probe is stopped occasionally to record the position of fractures (cracks) and breakouts, and also where a more detailed view of the borehole wall is needed.

A summary of borehole logging is provided in Table 1. The video inspection of the boreholes showed that nearly all holes are highly fractured at the collar. Axial viewing of the hole walls indicated that fractures (cracks) occur in all boreholes. The number of fractures varied from 3 to 10 at each hole and a sub-horizontal fracturing prevailed. Only occasionally vertical structures intersected the holes. Quartz veins and quartz stringers are common. Breakouts were observed in about 50% of the holes. They are distributed along the axis of the holes with no preferred locations. As a result of breakouts, few holes were blocked or caved, and had to be cleaned out prior to inspection. The blockage in hole No. ST22W07 could not be

Table 1 - Summary of Swellex borehole observations, Stobie Mine 2240 footwall drift. (Video tape copy No. 2).

Section	Hole ID No.	VCR Counter Position	Remarks
		0025-0068	Title and general information
01	ST22E01	0092-0330	
	ST22V01	0333-0525 →	(On tape ID No. = ST22E01,
	ST22W01	0530-0730	(label corrected at 0400.
02	ST22E02	0736-0910	On tape ID No. = ST22W01
	ST22V02	0914-1070	Large quartz vein
	ST22W02	1075-1270	
03	ST22E03	1280-1476	
	ST22V03	1487-1730	
	ST22W03	1735-1880	Recording repeated
04	ST22E04	1884-2124	Recording repeated
	ST22V04	2135-2256	
	ST22W04	2260-2460	
05	ST22E05	2468-2630	
	ST22V05	2635-2790	
	ST22W05	2797-2930	
06	ST22E06	2935-3075	
	ST22V06	3079-3218	
	ST22W06	3220-3340	
07	ST22E07	3343-3450	
	ST22V07	3455-3560	
	ST22W07	- -	Borehole blocked at 0.7 m
08	ST22E08	3564-3688	Vertical fracture, quartz filled
	ST22V08	3691-3795	
	ST22W08	3798-3965	Recording repeated (2x)
09	ST22E09	3967-4085	
	ST22V09	4088-4198	Some quartz stringers
	ST22W09	4200-4308	
10	ST22E10	4312-4382	Large quartz vein
	ST22V10	4385-4478	Quartz stringers
	ST22W10	- - *	Hole inspected with video probe
11	ST22E11	4490-4565	
	ST22V11	4565-4680	Recording repeated
	ST22W11	4680-4755	Quartz stringers



Cont.

Table 1 - Cont.

Section	Hole ID No.	VCR Counter Position	Remarks	Location of Cracks Depth of Hole (cm) 0 20 40 60 80 100 120 140 160 180
12	ST22E12	4755-4830		111 1 1 1
	ST22V12	4830-4905		1 1 1 11 B 1
	ST22W12	4905-4948	Some quartz stringers	1 11 1
13	ST22E13	4950-4995		11 1
	ST22V13	4995-5060	Recording repeated	1 1 Q
	ST22W13	5060-5100		1 1 B 1
14	ST22E14	5100-5150		11 1 1 1
	ST22V14	5150-5200		1 1 1 1 11
	ST22W14	5200-5244	Vertical fracture, quartz filled	11 1 1
15	ST22E15	5245-5285		11 Q 1
	ST22V15	5285-5335		1 1 1 Q 1 1 1
	ST22W15	5340-5385		11 1 1
16	ST22E16	5385-5415	Adjust 'Tracking' on VCR	11 Q 1
	ST22V16	5415-5445		11 B 1 1 Q
	ST22W16	5445-5475	Some quartz stringers	1 1 1 1 1 Q
17	ST22E17	5475-5505		1 1 1 11 1
	ST22V17	5505-5535	Some quartz stringers	11 1 1 1
	ST22W17	5535-5560		1 11 B 1 1 1
18	ST22E18	5560-5588		111 1 1 1
	ST22V18	5588-5620	Some quartz stringers	11 11 1 1 1 1
	ST22W18	5625-5655		1 1 B 1 1
19	ST22E19	5655-5675		11
	ST22V19	5675=5695		11 1 Q
	ST22W19	5695-5722		11 1 1 1 B B 1
20	ST22E20	5722-5745		11 1
	ST22V20	5745-5765		11 1
	ST22W20	5765-5785		11 1 1 Q 1

S ← Roofline of 2240 footwall drift → N

1 = fracture (crack), B = Breakout, Q = quartz stringer.

* - VCR malfunction, hole ST22W10 inspected with video probe but not recorded on tape; changed VCR unit.

Note: To improve the display quality occasional adjustment of 'Tracking' on VCR unit is required. Changes in counter position are expected using different VCR units.

removed, and therefore, the hole was not surveyed.

The underground environment of the test location was not suitable for the use of delicate video probe equipment. The support system (wire mesh) and particularly wet roof conditions hindered the surveying process. Moisture and high humidity in some holes affected the picture quality. The electrical power for instruments was supplied by a generator located in close proximity to the test site. Occasional voltage/frequency fluctuations from the generator caused disturbances in the performance of the video processor and also affected the recording quality of the VCR unit.

Optimum illumination was achieved by centering the video probe in the hole. The picture quality was excellent where quartz stringers and quartz veins intersected the holes. Video tape displays showed that a high resolution monitor, such as the one provided with the video probe unit, provided better pictures than a standard TV monitor.

CONCLUSIONS

The video borehole inspection showed that sub-horizontal fractures and occasional quartz stringers intersect nearly all roofbolt holes at the test site. The structural features are distributed along the boreholes with no distinct concentration at any particular portion of the holes. About 50% of the roofbolts displayed breakouts.

With regard to ground conditions and underground environment it appears that an optimum site has been selected for the in situ trial of Swellex roofbolts.

The video probe unit field trial showed that the performance of delicate instruments can be affected by high humidity and fluctuations in the power supply. For effective use of the unit, an adequately protected set-up of equipment in a rugged and particularly wet underground environment is

needed.

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R. Clarke, Mining Researach Laboratory, CANMET, acted as liaison officer on this project and assisted in the field work.

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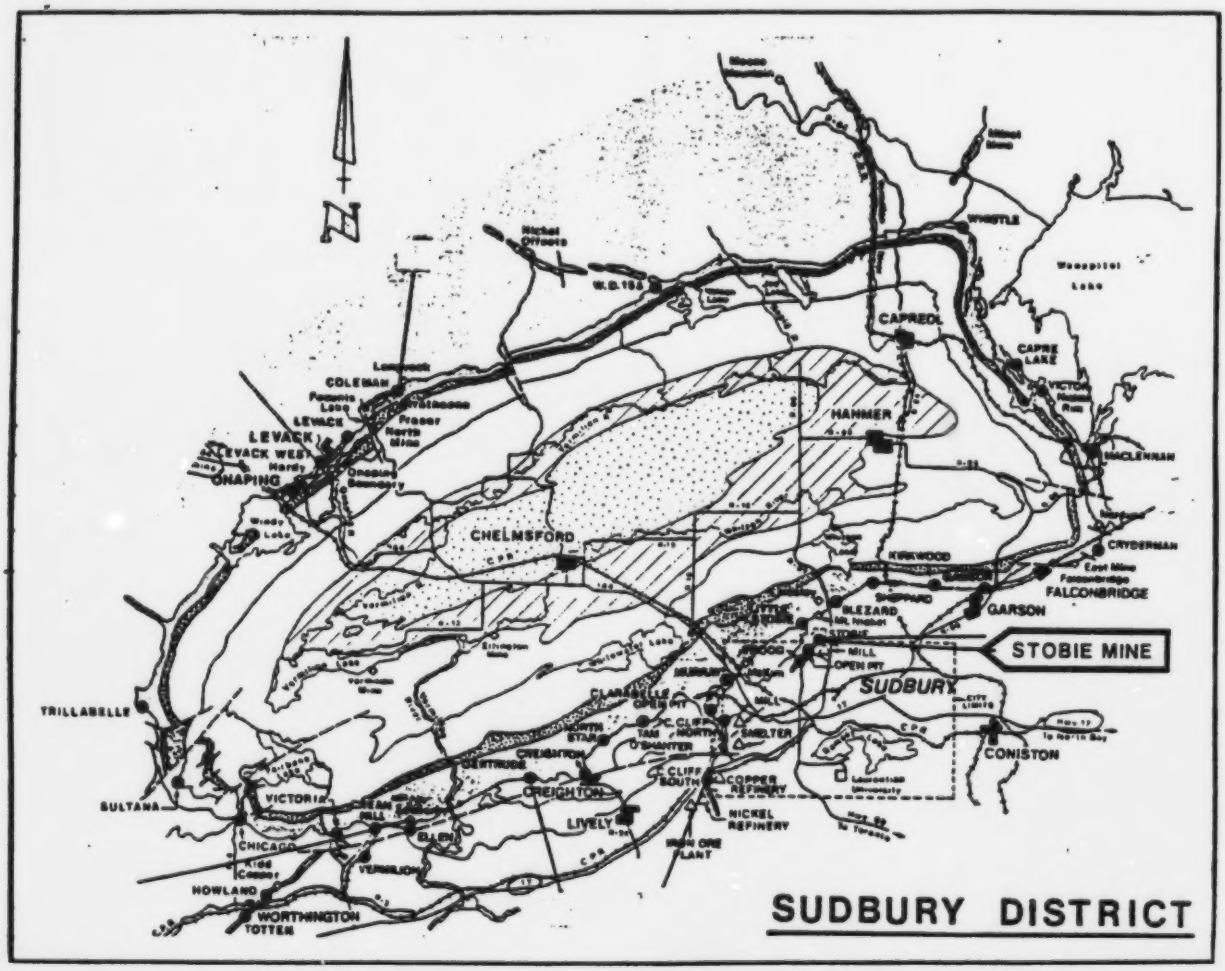

Fig. 1 - Sudbury mining district and the location of Stobie Mine.

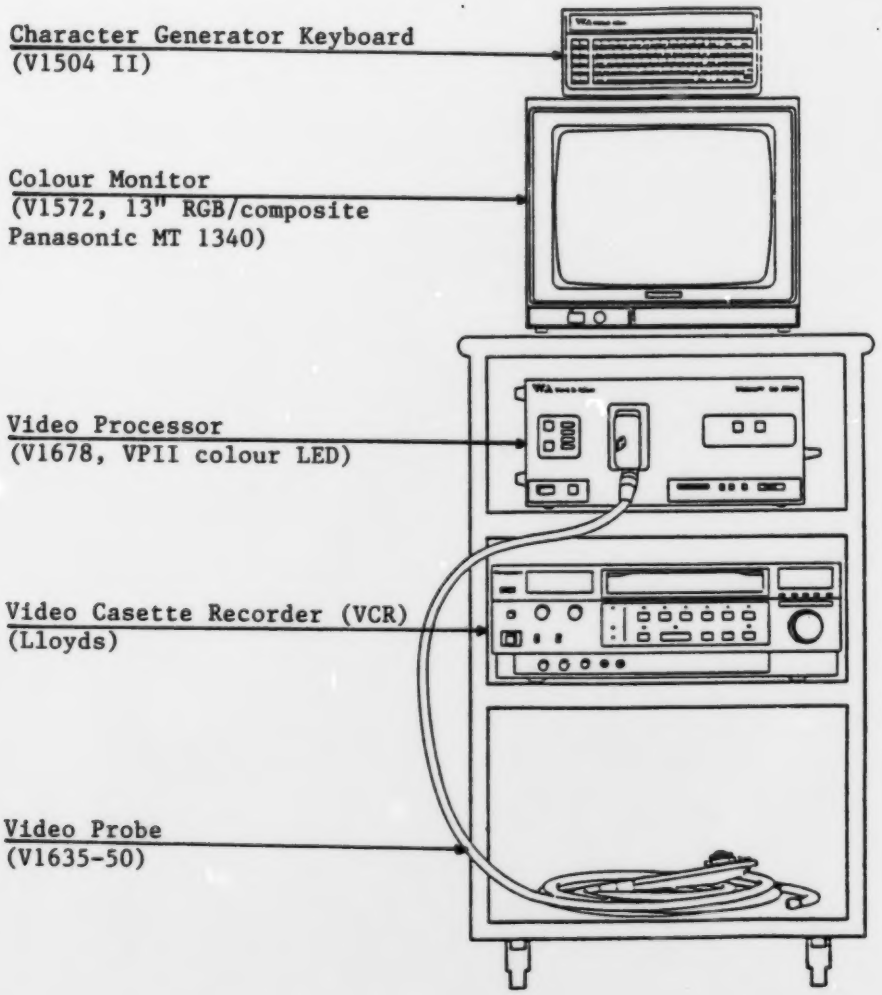

Fig. 2 - Video probe 2000 - system components (3).

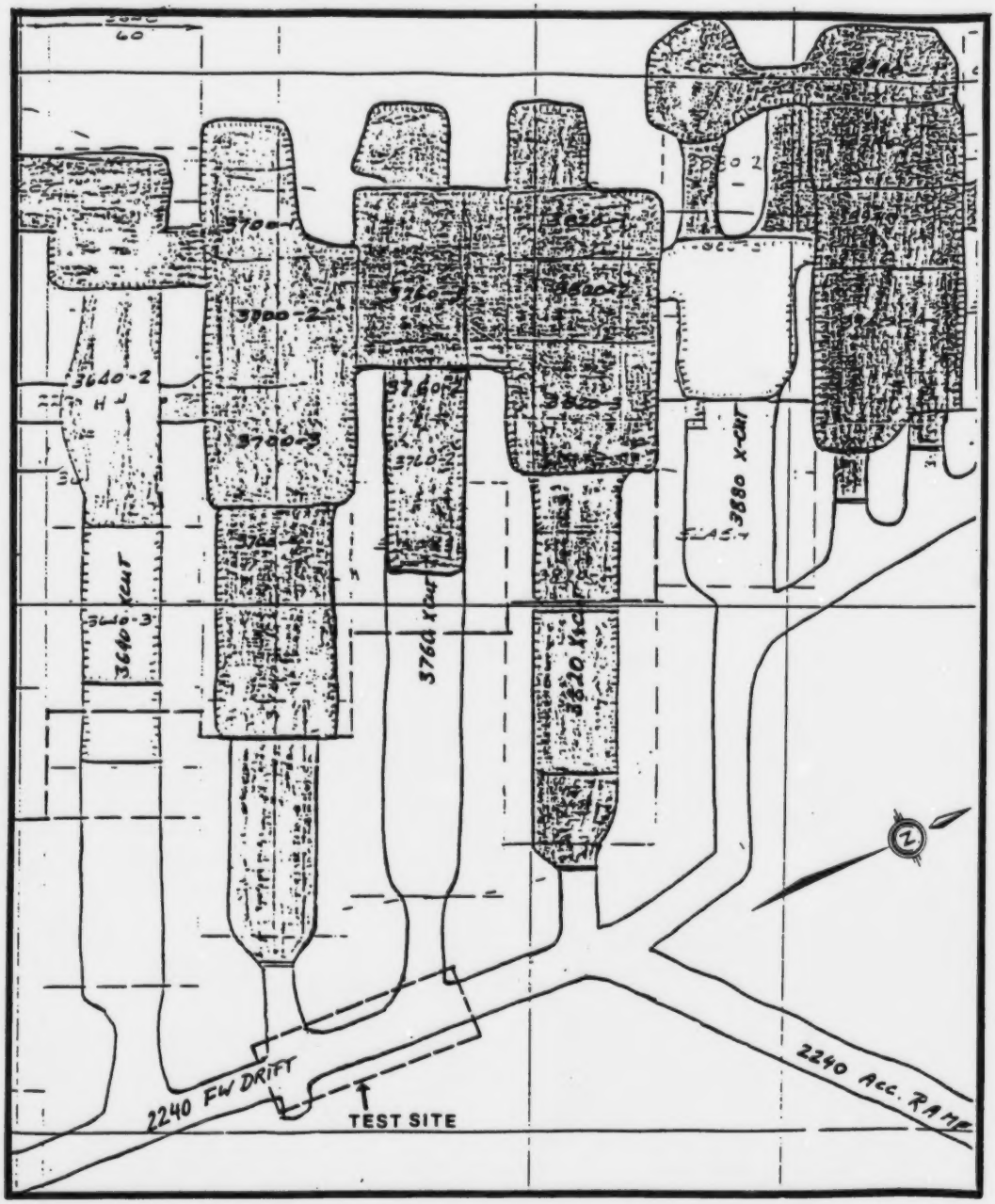

Fig. 3 - Mining layout at the test site.

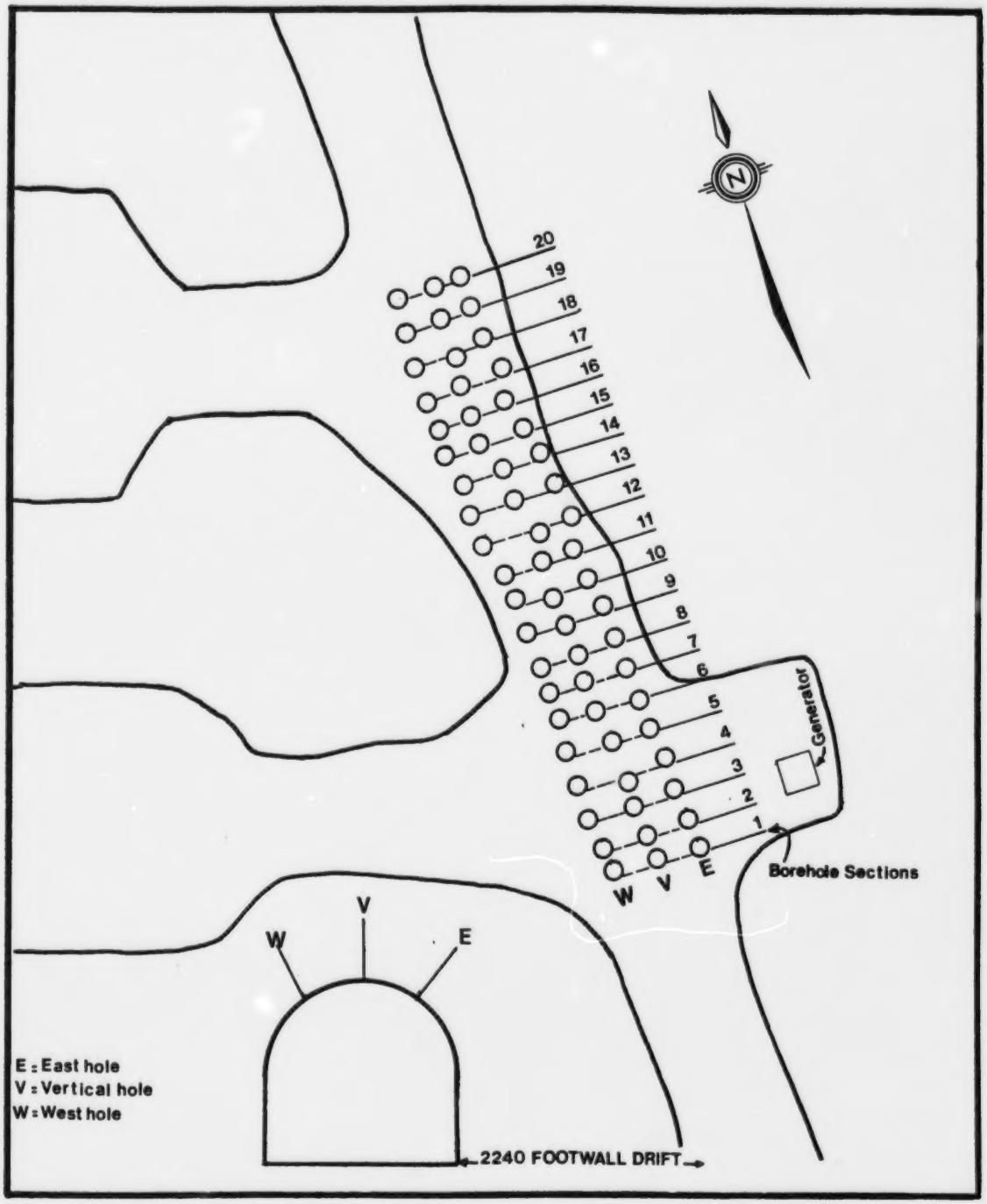

Fig. 4 - Layout of surveyed boreholes on the 2240 footwall drift.